CROTALARIA

Culture and Utilization

Farmers' Bulletin No. 1980
U. S. DEPARTMENT OF AGRICULTURE

CROTALARIA

A summer-growing soil-improving forage crop for the Southern States

Advantages:

Grows on sandy soils of low fertility.
Does not harbor nematodes.
Seeds easily and volunteers readily from stands once established.
Produces a good crop of readily harvested seed.
Increases yields of subsequent crops.
Frees soil of root knot nematodes when used in rotations or as an interplanted crop.

Requirements:

To insure germination, scarify the seed.
When it is grown with small-grain crops, seed in spring.
When it is grown with corn, seed several weeks before the corn is laid by or volunteers from a previous year's crop.
To make good forage, cut before flowering.

Precautions:

Keep livestock out of fields containing mature seed of poisonous species.
Use nonpoisonous species in new seedings.
Be sure seed is well matured before threshing.
Dry seed after threshing, to insure good germination after storage.

Washington, D. C. Issued October 1946

Crotalaria Culture and Utilization

By ROLAND MCKEE, *senior agronomist*, G. E. RITCHEY, *agronomist*,[1] J. L. STEPHENS, *agronomist*, and H. W. JOHNSON, *senior pathologist, Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration*

Contents

Crotalaria, a Southern Crop

CROTALARIA, in more than 600 species, occurs throughout the world, but only a few of these are of economic importance. The ability of the various species to grow on soils of low fertility and the fact that they do not harbor nematodes makes them especially valuable for use for soil improvement. Their ability to seed well and to volunteer from year to year under southern conditions insures a good soil-improving crop at low cost.

No figures on the acreage of crotalaria in the United States are available, but from general information it seems probable that in 1945 several hundred thousand acres were seeded for soil improvement. Because the various species tested make more growth in light sandy soil than most other plants, harbor no nematodes, and are well noduled with nitrogen-producing bacteria they are especially useful in the South, where nematodes are abundant and sandy soils predominate.

While the principal use of crotalaria in this country has been for soil improvement, the value of the nonpoisonous species for forage has been recognized. It is possible that this use should be extended.

Species and Varieties

The first species of *Crotalaria* introduced into the United States was brought from Brazil in 1899. Between that date and 1920, 10 other species were introduced from various foreign countries.

[1] Mr. Ritchey is also agronomist of the Florida Agricultural Experiment Station.

Figure 1.—*Crotalaria spectabilis* planted in wide rows, showing habit of growth.

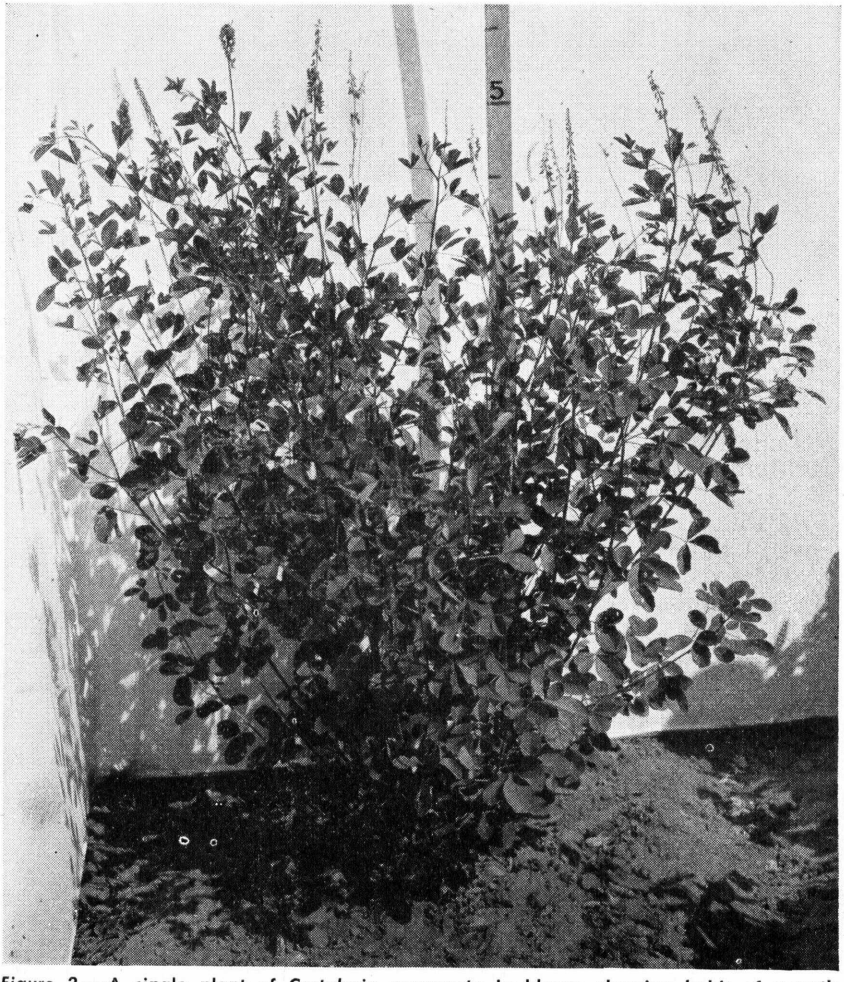

Figure 2.—A single plant of *Crotalaria mucronata* in bloom, showing habit of growth.

Figure 3.—A field planting of *Crotalaria intermedia* in bloom.

Figure 4.—*Crotalaria lanceolata* in pod, showing habit of growth.

The species most extensively grown in the United States are *C. spectabilis*,[2] *C. mucronata*, *C. intermedia*, and *C. lanceolata* (figs. 1 to 4). *C. incana* has made good growth in experimental planting and matures seed as far north as any species, although it has not as yet been used commercially.

C. juncea (fig. 5) is used to some extent for forage and soil improvement.

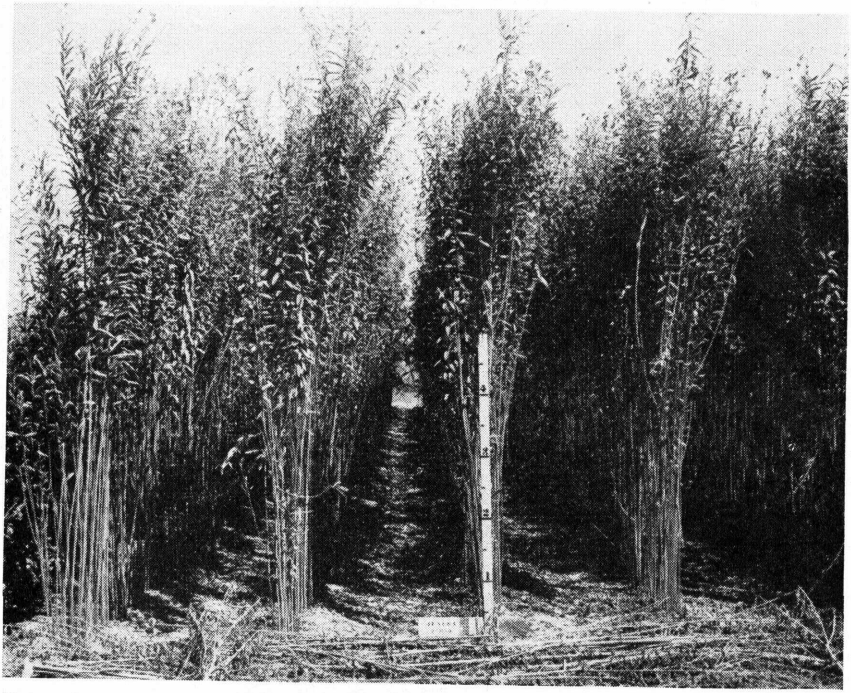

Figure 5.—*Crotalaria juncea* planted in wide rows, showing sparse setting of seed pods.

C. grantiana (fig. 6), with its fine stems and branching growth, has the appearance of a good forage plant, but is more exacting in growth requirements than a number of others.

The species of crotalaria used commercially are quite variable. In the United States two selected varieties of *C. spectabilis* and one of *C. mucronata* have been put into commercial use.

The selections of *C. spectabilis* are both early-maturing strains. One of these was developed by the United States Department of Agriculture under the name Early Spectabilis, No. 18096 (fig. 7); the other by the Alabama Agricultural Experiment Station with the designation Alabama No. 5. The early maturity of these selections makes seed production possible farther north and insures an earlier harvest farther south. The early varieties produce less vegetation than those maturing late, otherwise they are much alike.

[2] The abbreviation *C.* as used here and subsequently in the text indicates the scientific name *Crotalaria*. For those varieties and species of the plant that have not yet received common names it is necessary to use scientific names.

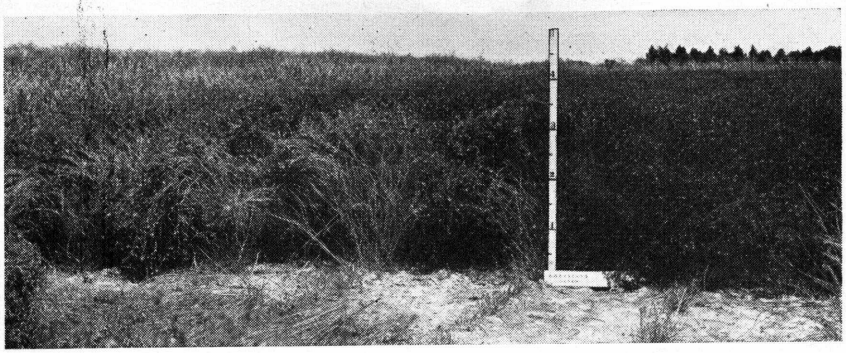

Figure 6.—Crotalaria grantiana planted in wide rows, showing fine stems and habit of growth.

Figure 7.—An early (left) and a late variety (right) of Crotalaria spectabilis.

A large-growing type of *C. mucronata* was selected at the South Carolina Sandhill Experiment Station and put into commercial production under the name Giant Striata. Aside from its generally larger size, this variety is much like the somewhat smaller growing strain of *C. mucronata.*

Climatic Requirements

Most species of crotalaria are tropical or subtropical in their requirements, and in the continental United States they are treated as summer annuals. Warm temperatures with moderate humidity seem to favor their growth. In experimental work with a number of species, a temperature of 28° F. has been the minimum that growing plants have

withstood without frost injury. Of the few species native to the United States, *C. angulata* is found as far north as southern Virginia, while *C. sagittalis* extends to the New England States. In their more northern limits these species behave as annuals, but in the South they are short-lived perennials.

Experiments indicate that some of the introduced species can be grown farther north than others. *C. spectabilis* and *C. incana* have matured seed as far north as Maryland, but cannot be depended on to mature regularly. *C. mucronata*, *C. intermedia*, *C. lanceolata*, *C. juncea*, and other species have failed to mature in Maryland. Under irrigation in the Southwestern States the several species that have been tried (*C. spectabilis*, *C. mucronata*, and *C. juncea*) have made fair growth whenever stands have been obtained, but the establishment of stands is somewhat difficult. Seedings must be made after the weather is warm, and the quick drying and baking of the soil at that time interferes with seedling emergence.

Soil and Moisture Requirements

Crotalaria is much better suited to poor sandy soils than most crops, and it is for such situations that it has attracted special attention. On more fertile soils it makes correspondingly better growth, but other crops can be grown there. Experience has indicated that crotalaria needs a well-drained soil and is not adapted to heavy clay. It will make good growth on most soils of the Coastal Plain region of the Southeastern States.

Seed Characteristics

Seeds of crotalaria remain viable for a number of years. Deterioration is slow and gradual, unless during or subsequent to harvest the seed has been scarified, that is, scratched to aid germination. When once the seed is scarified, deterioration is much more rapid, but even then it remains viable for several years under good storage conditions. The percentage of hard seed is high. Since threshing with an ordinary thresher may scarify only 40 percent of the seed, about 60 percent or more hard seed will ordinarily remain in untreated seed and this will produce volunteer growth in cultivated fields for a number of years without reseeding. The weight of crotalaria seed is about 60 pounds per bushel.

Commercial scarifying machines are available in the trade. The abrasives used in their construction usually are sandpaper, emery cloth, or sandstone. A small concrete mixer can be used as a scarifier by first adding to the seed coarse stones the size of large marbles or larger. If the concrete mixer is rotated for about 1 hour with stones and seed in equal bulk, reasonably good scarification should be effected. This method of scarification is described in Department of Agriculture Leaflet 107, The Barrel Seed Scarifier. The scarified seed can be easily separated from the stones by screens.

Seedbed Preparation

Since seed of crotalaria is comparatively small, thorough seedbed preparation is necessary for the first seeding to insure a prompt and

good stand. Subsequent stands, which will be largely volunteer, can be assured by ordinary cultivation or disking to check other plant competition and by putting the ground in reasonably good tilth. Crotalaria does well in cultivated fields either as a first crop or volunteer. No special conditions are required to obtain stands.

Fertilizer and Lime Requirements

Crotalaria will grow at a comparatively low soil-fertility level and has been used especially on sandy soils of low productivity. Continued production on such soils, however, will necessitate the addition of fertilizer for crops following crotalaria. When a heavy crop is desired, even though the crotalaria is to be used for green manure, fertilizing with superphosphate and potash is recommended. On acid soils a moderate quantity of lime has benefited crotalaria, and its use in addition to the fertilizer is necessary for the best production.

Seeding

For maximum growth on prepared seedbeds, seeding should be done after all danger of frost is past, about the same time as corn planting or a little later. Earlier seeding is advisable in oats or other small grain. When planted early under such conditions, the seed becomes covered and is ready to grow by the time the weather is warm. Seedings can be made broadcast or drilled. In drilling, the rows can be close, as with small grains, or wide, as with corn and sorghum. Rows can be wide when seed is limited or it is desired to control weeds by cultivation. They also may make seed harvesting by hand easier. Use of a combine in harvesting will be facilitated if time of seeding is delayed, so as to reduce the height of the plants. The rate of seeding varies with the different species, depending on the size of the seed. Suggested rates for both broadcasting and wide-row planting are given in table 1.

TABLE 1.—*Source, rate of seeding species of crotalaria, and number of seeds per pound of each*

Species	Source	Seeds per pound	Broadcast	3½-foot rows
		Number	*Pounds per acre*	*Pounds per acre*
C. anagyroides	Brazil	25, 000	20–30	5–6
C. grantiana	Africa	150, 000	10–13	2–3
C. incana	British Guiana	85, 000	10–20	3–4
C. intermedia	Africa	100, 000	10–15	2–4
C. juncea	India	15, 000	20–40	5–7
C. lanceolata	Africa	170, 000	8–12	2–3
C. mucronata	do	75, 000	10–20	3–4
C. retusa	Egypt	30, 000	15–25	4–6
C. spectabilis	Africa	30, 000	15–25	4–6
C. usaramoensis	Java	160, 000	8–12	2–3

Wherever planted in the United States, crotalaria has made good growth and developed many nodules (fig. 8), so that artificial inoculation does not seem necessary.

704874°—46——2

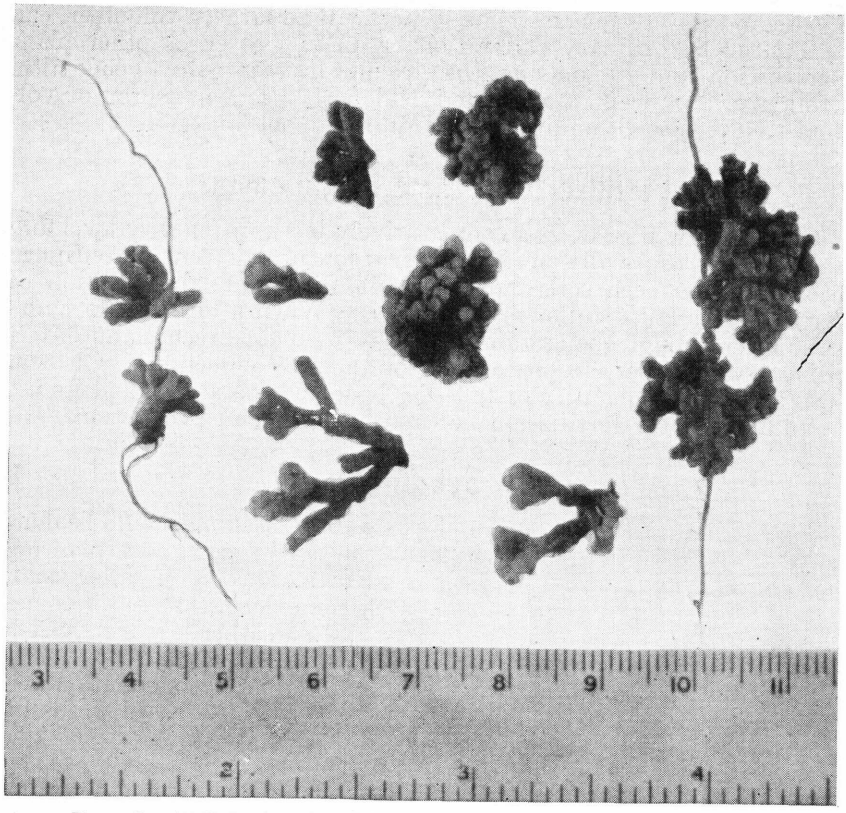

Figure 8.—Well-developed nodules from the roots of *Crotalaria mucronata.*

Thousands of acres of crotalaria are seeded for cover and green manure in tung groves (fig. 9). It is also planted extensively in connection with peanuts, truck crops, and corn. Planting crotalaria in

Figure 9.—*Crotalaria spectabilis* in a young tung grove on Norfolk sandy loam.

spring in small grain and allowing it to continue after the grain has been harvested is one of the best soil-improving practices.

The fact that nematodes cannot live in the roots of crotalaria makes the crop especially good for truck croplands or for other lands where nematode-susceptible crops are being grown. It is valuable also for reducing the damage of nematodes to peach trees. On lands not growing a cash crop, a winter cover crop of rye or a winter legume should follow crotalaria in fall.

Crotalaria will not choke out Bermuda grass, as is sometimes suggested. This is because Bermuda grass grows all summer, while crotalaria produces a shade crop only during the latter part of the summer after Bermuda grass has already had half a season's growth.

Use for Soil Improvement

Crotalaria is used most extensively for soil improvement. The species grown for this purpose in the United States are *C. spectabilis*, *C. mucronata*, *C. intermedia*, and *C. lanceolata*. Other species have been used in other countries, but the ones named are preferred in the United States. *C. mucronata* was the first species to be grown extensively, but it gave way to *C. spectabilis*, which the growers prefer because its less woody stem makes it easier to turn under and handle with the light plows and other implements available in the South.

In citrus and pecan groves the use of *C. mucronata* was discontinued, as it harbored pumpkin bugs, which damage both citrus and pecans. The seed habits of *C. spectabilis* are also somewhat better in the lower South, where crotalaria was first grown.

Crotalaria juncea is a good soil-improving crop, but lack of seed in quantity has kept it from being more generally used. It makes good growth, much more rapid than other species, in experimental plantings. This gives it an advantage where weed competition is a problem or where a quick early cover crop is desired. Unfortunately, *C. juncea* does not seed well in most sections of the South and has produced seed commercially in only the most southern part of Texas.

Use in Rotations

On poor lands that cannot be cropped every year one can well afford to grow crotalaria in the years the land does not produce a cash crop. Land once seeded to crotalaria will produce volunteer crops in succeeding years with proper management, and thus reduce the cost of seeding. When crotalaria is seeded in small grain and grown following the harvesting of the grain, allow the crotalaria to mature some seed each year to induce volunteering, or mature a full crop occasionally. Crotalaria grown with corn should be seeded several weeks before the corn is laid by, or it may be volunteered from a previous crop. In most seasons this allows enough time for some seed to mature and insure volunteering.

In experimental plantings increased yields of corn and other crops have followed the use of crotalaria in rotations and interplantings, with maximum increases equaling 100 percent. In an experiment reported by the Mississippi Agricultural Experiment Station, the interplanting of crotalaria in corn increased the corn yields from 7.8

to 14.5 bushels per acre as an 8-year average. When corn was grown every other year in rotation with crotalaria, the total production for the 4 years was more than in 8 years continuously without crotalaria. The corn yield on the rotated plots averaged 20.5 and 22.7 bushels per acre in 4 years for the two series against the 7.8 bushels continuously through the 8 years. Thus, corn and crotalaria in rotation, which gave a corn crop only every other year, produced more corn in the 8-year period than corn grown continuously, the increase being about 40 percent.

Experiments made over a 5-year period at Holly Springs, Poplarville, and Raymond, Miss., agreed with these findings and indicated that crotalaria, on both sand and silty loam, improved corn yields when rotated with it, planted in the same drill, or just before the corn is laid by. At Holly Springs, 400 pounds of 2–8–4 fertilizer was applied to all plots, while a similar quantity of 4–8–4 was used at Poplarville and Raymond.

When corn is planted on land where crotalaria was previously grown and allowed to mature seed or on land where crotalaria was seeded early in the season, 8 to 10 tons of cover crop may be obtained after the corn is laid by. Planting crotalaria seed in corn middles at the time of laying by the corn, however, sometimes failed because the plants often get started too late to make satisfactory growth. Seed that has carried over in the soil and is all ready to grow at the time of the last cultivation germinates as soon as cultivation is stopped and makes satisfactory growth.

When crotalaria is grown with a small-grain crop, the grain is treated exactly as if it were grown alone, and is harvested with binder and combine.

In February or early in March, crotalaria seed is sown broadcast on the young grain at the rate of about 25 pounds per acre. It is advisable, though not necessary, to go over the grainfield with a drag harrow or weeder after the crotalaria is planted, to stir the soil and cover the seed. The grain will mature late in spring or early in summer. At this time the crotalaria plants are only a few inches high. After the grain has been removed, the young crotalaria plants grow rapidly in the stubble and by October are shoulder to head high.

Where there is much weed competition crotalaria does better in combination with grain than when sown broadcast alone, because the grain stubble has less weeds than freshly turned soil.

If crotalaria is allowed to mature seed for reseeding, the grain that follows cannot be planted until quite late. An early strain of spectabilis crotalaria is often desirable, as the seed ripens sooner and permits earlier planting of the grain.

After a good seed crop is once obtained, reseeding is assured. The quantity of seed that matures before frost varies from 200 to 500 pounds per acre, depending on the section in the South and date of the first severe cold. Light frosts do not kill crotalaria. After the first year, even the complete loss of 1 year's seed crop does not affect reseeding very much, as enough hard seeds for reseeding carry over 2 years.

The following results were obtained at Tifton, Ga., on about 40 acres in two fields of poor Norfolk sandy soil:

Field No. 1.—Oats were grown with no fertilizer, except 100 pounds of sulfate of ammonia used as top dressing. In February, spectabilis crotalaria was seeded at the rate of 25 pounds per acre. After the crotalaria was mature, 3,000 pounds of seed was harvested from the 40 acres and enough was left for abundant reseeding. The oats yielded 25 bushels per acre. After 2 years in crotalaria, the field was again planted to oats and top-dressed with 100 pounds of sulfate of ammonia. The yield of oats was 34.4 bushels per acre, an increase of 9.4 bushels per acre, as a result of 2 years of crotalaria.

Field No. 2.—Oats yielded 28 bushels per acre, with no fertilizer except 100 pounds of sulfate of ammonia. Cowpeas were planted in this field and harvested for hay. After 2 years this field was again planted to oats and top-dressed with sulfate of ammonia. The yield was 28.5 bushels per acre.

Use as a Forage Crop

Value

No species of crotalaria is used extensively as forage. Though experimental work has been too limited to determine the relative value of the different forms, it is known that *animals will eat both the poisonous and the nonpoisonous species.* The only species that has been used to any important extent in feeding trials is *C. intermedia. C. mucronata* is the form most used by stockmen for grazing. Experiments with *C. intermedia* have been largely with silage. The Florida Agricultural Experiment Station, reporting on digestion trials with steers, showed that *C. intermedia* silage harvested in the bud stage, with 27 percent of dry matter, provided 2.1 percent of digestible crude protein and 10.7 percent of total digestible nutrients.

In the limited quantities that Jersey cows with a basal ration of corn silage and mixed concentrates would consume, it was computed that 107 pounds of dry matter in *C. intermedia* silage are equivalent to 100 pounds of dry matter in No. 1 green alfalfa hay for milk production. The cows refused 20 percent of the *C. intermedia* silage, 7 percent of the corn silage, and 5.6 percent of the alfalfa hay.

Feed flavor was less noticeable in milk from cows receiving *C. intermedia* silage and a basal ration of corn silage and mixed concentrates during milking time than from cows fed a similar basal ration with either No. 1 green alfalfa hay or young mixed grasses.

As crotalaria is a coarse, fibrous plant, it is not well adapted for hay. When cut quite early (before bloom), a fair forage can be produced. *C. mucronata* has been used for pasture in open woodland that is too cut up or filled with stumps to be readily cultivated and on poor sandy land that will not grow other plants satisfactorily. For such situations *C. mucronata* has value and should receive more attention. *C. lanceolata, C. intermedia,* and other species should be used in the same way. The volunteering ability of these species, together with good seeding habits and hard seed, reduces maintenance cost to a minimum by making sufficient seed continuously available.

Harvesting

Crotalaria is not likely ever to have much use as a commercial hay crop. In experimental plantings it has been cut for hay with an ordinary mower (fig. 10). Mature plants are difficult to cut because

of the woody texture of the lower part of the stem. Cut material allowed to dry in the swath loses much leaf and, when put into windrows before it is dry, it cures very slowly on account of the coarse stems. Curing is more satisfactory when freshly cut crotalaria is made into bundles and then shocked (fig. 11). At best, it is difficult to harvest and even more difficult to cure. Its most satisfactory use for forage has been as silage. When cut green and put into the silo, it can be handled satisfactorily with an ordinary threshing machine and silage cutter.

Figure 10.—Cutting *Crotalaria intermedia* with an ordinary mower.

Figure 11.—*Crotalaria intermedia* in shocks.

Yields

On fertile soils crotalaria makes very strong growth and gives heavy yields. More than 30 tons of green weight per acre has been reported for *C. spectabilis*. Many other species give similar yields. A good average yield is 10 tons per acre, which is equivalent to about 2 tons of dry forage. Yields of air-dry hay of *C. intermedia*, as reported by the Florida Agricultural Experiment Station, ranged from 1,860 to 3,500 pounds per acre. On poor sandy soils growth is weak and yields correspondingly light. In one test, *C. intermedia*, at

Gainesville, Fla., on unfertilized sandy soil yielded only 4 tons of green matter per acre.

Harvesting for Seed

Methods

Crotalaria seed is harvested with combines (fig. 12) and mowers and by hand-picking. Some species ripen seed fairly uniformly, and these are best suited for handling with machinery. Species that ripen unevenly or through a long period must be harvested by hand to obtain a maximum quantity of seed.

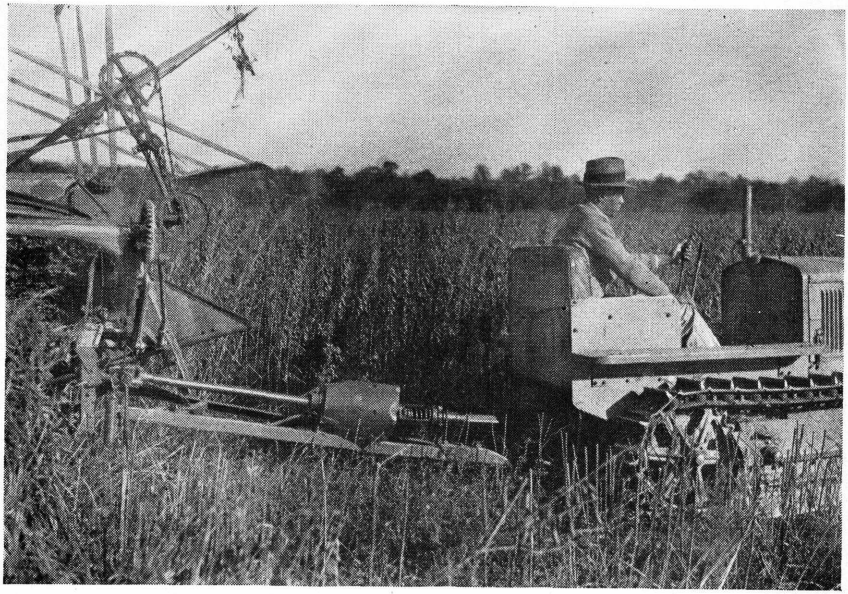

Figure 12.—Harvesting *Crotalaria spectabilis* with a combine.

Of the species mentioned in this bulletin, *C. spectabilis* and *C. lanceolata* are perhaps the easiest to handle for seed and *C. anagyroides* the most difficult, as it is a very large and coarse plant and ripens its seed unevenly. Late planting will reduce the size of plants to some extent and still permit seed setting; the smaller plants make harvesting easier. In Texas, July-planted *C. juncea* made about half as much growth as when planted early and matured seed that could be easily harvested with a combine. Crotalaria is not difficult to thresh when dry, but it will give trouble when harvested before fully mature. The threshed seed must be dried artificially or spread thinly on shed floors to dry naturally. Allowing the seed to heat reduces germination. When hand-harvested, the seed pods are gathered and spread to dry before being hulled or threshed. Special crotalaria threshers have been built, but ordinary threshers properly adjusted will hull the seed satisfactorily. By the use of screens and ordinary fanning mills, the seed can be cleaned without difficulty.

Yields

In the southeastern United States, *C. spectabilis*, *C. mucronata*, *C. intermedia*, *C. lanceolata*, and *C. incana* have set good crops of seed. *C. retusa* and *C. grantiana*, under some conditions, produce good seed crops. *C. retusa*, however, is subject to disease, which in the lower South has sometimes destroyed plantings; and *C. grantiana* often fails to mature seed properly on account of weather conditions and insects. *C. usaramoensis*, *C. anagyroides*, and *C. juncea*, although blooming freely, usually set very little seed. Of the species grown commercially, *C. spectabilis* probably produces the most seed, yielding about 500 pounds per acre as a good average. *C. intermedia* and *C. mucronata* yield somewhat less, averaging about 300 pounds.

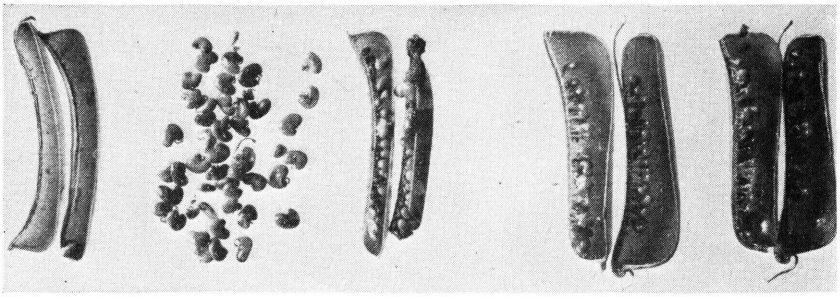

Figure 13.—Crotalaria mucronata seed and pods.

Seed of *C. intermedia*, *C. spectabilis*, and *C. mucronata* (fig. 13) has been produced in quantity and is available through commercial seed firms of the South. Seed of *C. juncea* has been produced in southern Texas, but is not available in large quantity. None of the other species are grown commercially for seed in the United States, although small quantities of *C. lanceolata* and *C. incana* have been produced by a few growers for their own use.

Ornamental Value

Many species of crotalaria have large, conspicuous flowers that make them well suited for ornamental purposes. For a number of years *C. retusa* has been used in the home flower garden and by florists, and more recently *C. usaramoensis*, *C. spectabilis*, and *C. mucronata* have come into quite general use. The usual blooming period is from midsummer to early fall, and, as the season of bloom is somewhat continuous, the plants are conspicuous for a long time. *C. retusa*, which is comparatively small, is suitable for a low border. The other species mentioned attain a height of 5 feet or more and must be grown where there is plenty of space.

Chemical Analyses

Most of the chemical analyses reported for crotalaria are from the Florida Agricultural Experiment Station. Tests indicate that the various species are relatively high in protein, averaging about 17 per-

cent when cut early, but decreasing to about 10 percent with advance toward maturity. A change in composition with development is important in connection with both feeding and fertilizer value of crotalaria. The fiber content is high and increases to as much as 47 percent at maturity.

When crotalaria is used as a green-manure crop, the quantity of nitrogen needed and the time it is to be available must be kept in mind to determine at what stage to turn it under. If a maximum quantity of nitrate is desired immediately, as for truck crops, the crotalaria should be plowed under in its early stages of growth, when the nitrogen is high and decomposition rapid. If, however, the nitrate is not needed at once, as for late winter use by trees in orchards, the mature crop should be worked into the soil before the time of tree growth in spring.

While crotalaria is recognized as only a second-rate forage, its feeding value is increased with increase in protein and it should be pastured or cut during the early stages of development, when protein content is highest.

Palatability to Livestock

Animals do not readily eat any of the species of crotalaria. Cattle and mules have browsed all species grown, including *C. spectabilis*, which is poisonous, but no species has been used extensively for forage. In tests of several species for palatability of hay, conducted at the Florida Agricultural Experiment Station, *C. intermedia* and *C. incana* were found most readily eaten. *C. lanceolata*, *C. usaramoensis*, and *C. grantiana* followed in the order given, and *C. spectabilis* and *C. mucronata* were found least palatable. Although the hay of *C. spectabilis* is the least palatable, it was eaten in sufficient quantity to cause poisoning, and three yearling cattle used in the test died 6 to 8 weeks after the trials were begun.

In attempts to determine the relative palatability of the green plants for pasture, little success was attained in getting cattle to eat any of the species. *C. mucronata*, *C. lanceolata*, and other species in waste places and woods pastures are grazed when other feed is not abundant, but are not so palatable as the native grasses.

In palatability trials of seven species made into silage, cows ate *C. intermedia* silage most readily, with *C. lanceolata*, *C. incana*, and *C. spectabilis* following in the order named. Silage from *C. mucronata* seemed to be distasteful, although it was of good color and odor. With only limited experimental data available and with a lack of actual use by stockmen of the various species, it is not possible to state their real palatability, but it is known that livestock eat many of the species to a limited extent.

Species Injurious to Livestock

The species of crotalaria reported as poisonous to livestock include *C. spectabilis*, *C. juncea*, *C. burkeana*, *C. dura*, and *C. sagittalis*. A few others are reported as suspected.

Investigations conducted by the Florida Agricultural Experiment Station show conclusively that C. spectabilis, *the species grown most extensively in the United States, is poisonous to cattle, swine, sheep,*

goats, chickens, ducks, and turkeys and not uncommonly causes loss of cattle in the South. For this reason neither this nor other poisonous species should be used in new plantings. When other feed is available, animals usually avoid the poisonous crotalaria, but in winter, when feed is scarce, they may consume a sufficient quantity to cause trouble.

The native species C. sagittalis *seldom occurs in sufficient abundance to be dangerous, but as far as possible its use should be avoided. The only other poisonous species grown in the United States is* C. juncea. *This sets seed sparingly in most places in the South and the plant not in seed probably never contains enough alkaloid to be dangerous. Like the other poisonous species, however, it should be kept from livestock.*

Diseases

Diseases have caused more or less damage at times to all the species of crotalaria that have been used in experimental plantings. No widespread epidemics of disease have ever been reported in farmers' plantings, however, and crotalaria can be depended upon to produce as regularly as any other crop.

Anthracnose, caused by the fungus *Colletotrichum crotalariae*, attacks the stems of both *Crotalaria spectabilis* and *C. mucronata* and kills the bark, which then sloughs away. Where the disease occurs it is severe, but generally the loss is not extensive.

Stem canker of *C. spectabilis*, caused by the fungus *Diaporthe crotalariae*, occurs in central Florida and in certain fields is reported to have killed as many as 30 percent of the plants by blooming time.

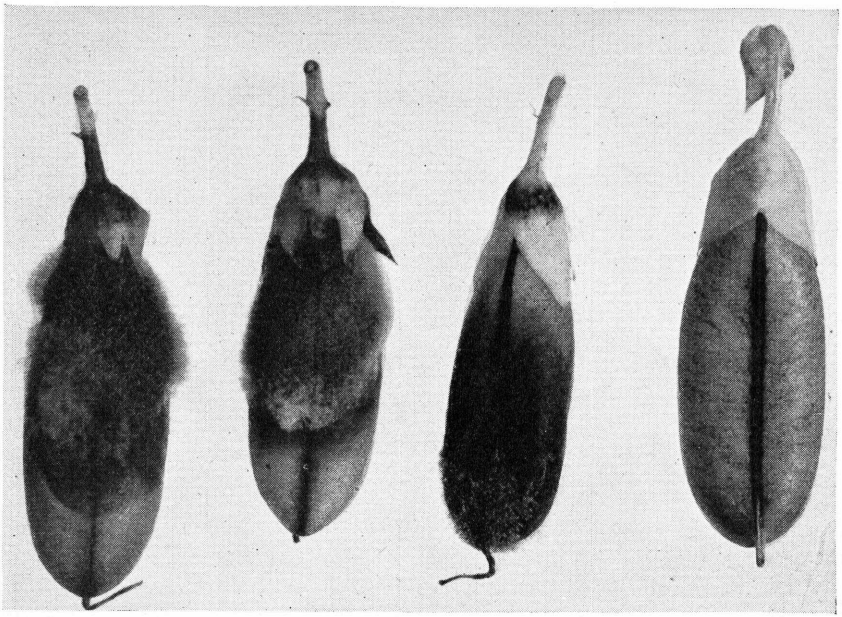

Figure 14.—Three *Crotalaria spectabilis* pods (left) attacked by the gray mold disease, compared with a healthy pod (right).

While the attacks are severe, this disease appears to be of limited distribution and so far has been found on *C. spectabilis* only.

Southern blight, caused by the fungus *Sclerotium rolfsii*, also attacks the stems of the plants, girdling them at or near the soil line. Numerous small round brown sclerotia resembling mustard seeds are produced on the stems attacked or on the soil in the immediate vicinity. This fungus is widely distributed in southern soils and attacks crotalaria wherever it is grown, appearing more or less commonly on both *C. spectabilis* and *C. mucronata*.

Gray mold, caused by the fungus *Botrytis cinerea*, has been a conspicuous disease of *C. spectabilis* in certain seasons in Florida. After blossoming time, the fungus is prominent on the stalks and seed pods and commonly forms spots on the leaves. The fungus develops spores in abundance on the areas involved, forming a gray feltlike layer from which the common name of the disease was derived (fig. 14).

Leaf spot, caused by the fungus *Cercospora crotalariae*, occurs on both *Crotalaria spectabilis* and *C. mucronata* and on the former may become serious enough to cause considerable defoliation by late summer. While widely distributed, this disease as a rule is not particularly serious.

Damping-off of crotalaria seedlings may result in a considerable degree of loss during periods of cool wet weather in spring. This disease is caused by the fungus *Rhizoctonia solani* and does not appear to be limited to any specific species of host plant. The fungus attacks the seedling stems at the soil line, girdling them and causing the seedlings to damp off in typical fashion.

A virus disease characterized by a general stunting of the plants, by mottling, blistering, and malformation of the leaves, and in most cases by abnormally stimulated lateral branching, or witches'-broom, was prevalent on seven species of crotalaria grown at Arlington Experimental Farm, Rosslyn, Va., in 1937. While this disease has not been reported from the southern United States, it is interesting to note that a mosaic of *C. mucronata* that dwarfs the plant and reduces seed production was reported in 1931 from Puerto Rico and a witches'-broom disease of *C. juncea* and *C. anagyroides* was reported in 1927 from Java.

While there are no specific remedies for the diseases of crotalaria, they can be largely avoided by thoroughly plowing under the old plants, thereby reducing the quantity of infectious material carried over from one year to the next.

U. S. GOVERNMENT PRINTING OFFICE: 1946

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Price 10 cents